APPROACH TO IMPACT ANALYSIS WORKSHOP

Fish, Vegetation, Wildlife and Special Status Species

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CALFED
BAY-DELTA
PROGRAM

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ENVIRONMENTAL VARIABLES

Environmental variables represent structural components of the ecosystem including physical, chemical and biological features. Ecosystem structure is reflected in the interrelationship and organization of these components. Change in the environmental variables affects ecosystem functions and associated species within the ecosystem. Definitions of environmental variables are provided below.

Flow

Flow includes several parameters directly related to flow volume in rivers, streams and the Bay-Delta estuary. The parameters include instream flow, net channel flow, tidal flow and estuarine salinity.

INSTREAM FLOW. Instream flow is the rate of water movement past a specific point in rivers and streams. Instream flow is affected by weather, reservoir operations, diversions, tributary inflow, groundwater and drainage.

NET CHANNEL FLOW. Net channel flow is the rate of water movement past a specific point in the Bay-Delta estuary, not including tidal flow. Net flow in a Delta channel is affected by weather, tides, tributary inflow including effects of upstream reservoir operations, diversions, groundwater, flow division to Delta channels including the effects of barriers and channel morphology, drainage and potential discharge from future in-Delta water storage facilities. Commonly calculated net flows include Delta inflow, San Joaquin River flow past Jersey Point, and Delta outflow.

TIDAL FLOW. Tidal flow is the average channel flow attributable to ebb or flood tides, not including net flow. Variables related to tidal flow include water surface elevation, tidal excursion (i.e., movement of a mass upstream and downstream with the ebb and flood tides) and tidal prism (i.e., the volume of water that moves past a location as the result of a change in tidal stage). Local factors affecting tidal flow include morphology of the tidal basin, weather and Delta inflow.

ESTUARINE SALINITY. Estuarine salinity is measured as concentrations, electrical conductivity units and geographical location. Estuarine salinity is a function of mixing ocean salinity with freshwater inflow and does not include land-derived salinity, which is discussed under "Water Quality." Delta outflow, tidal flow and estuary morphology affect the distribution of salinity in the estuary.

Reservoir Water Surface Elevation

Reservoir water surface elevation refers to water surface elevation at a specific time. Reservoir water elevation is a function of reservoir inflow including factors affecting instream flow; and outflow as affected by reservoir operations, groundwater percolation, evaporation and reservoir morphology.

Diversions

Diversion is the volume of water removed from a water body by pumps, siphons and gravitational flow. Diversions reduce instream and net flows. Diversion facilities have structural components related to channel morphology, intake design and size, fish screens, debris screens, pilings, and other structures associated with protecting the diversion facility and facilitating operations. The effects of diversions and diversion facilities on fish and the aquatic ecosystem are determined by flow, diversion volume, facility design including fish screens, facility location, channel morphology, water quality and species interactions such as predation.

Barriers

Barriers are any structures that direct or influence the movement of organic and inorganic material along specific pathways. Barriers for aquatic organisms include dams, temporary physical obstructions of rock and other materials, gated structures, acoustical barriers, electrical barriers, air-bubble barriers and louvered barriers. Barriers for terrestrial organisms may include mountain ranges, urban areas, roads, waterways, reservoirs and other water bodies. Barriers may affect movement of organisms without affecting flow of other material. Barriers are sometimes associated with diversion facilities, and the effects of barriers and diversions may be difficult to separate. The effects of barriers are determined by flow, ratio of the flow division, facility design, facility location, channel morphology and species interactions such as predation.

Physical Habitat

Physical habitat represents the shape and form of the ecosystem including surface contours; elevation; gradient; and surface features such as trees, woody debris, rocks, boulders and bridge abutments. For reservoirs, physical habitat includes shoreline circumference, surface area, depth, depth contours, rock outcroppings, woody debris and vegetation. For rivers and streams, physical habitat includes channel pattern (braided, meandering, or straight), width, depth, meander geometry, cross-sectional profiles, riffle-to-pool ratios, boulders and rock outcroppings, woody debris and vegetation. For terrestrial communities, physical habitat also includes slope, exposure, and surface features including soil surface texture, rocks and boulders.

Substrate is part of the physical habitat and is defined by physical composition including particle size and shape, chemical composition, density, erodibility, permeability, organic content including benthic organisms such as Asian clams, and stability. Substrate is affected by erosion, deposition, transport processes that are a function of flow or wind, physical habitat, barriers to movement of material such as dams, biological activity (e.g., burrowing organisms), source materials, and human actions including gravel cleaning, gravel addition and dredging.

Physical habitat also includes inlets and outlets, channels, islands, fetch and exposure. Human-created features such as bridge abutments, riprap, gabions, pilings, piers, boat ramps, docks, artificial reefs and other human-made structures are also part of physical habitat. Physical habitat is affected over the long term by weather, geology and geologic events, and over the short term by weather, flow, biological processes, and human modification including dredging, levees and bank protection.

Water Quality

Water quality is a broad category that includes chemical, physical and biological characteristics of water that may be attributable to natural and human-induced conditions. Water quality is influenced by reservoir operations, municipal and industrial discharge; agricultural and urban runoff; direct application of pesticides; and dredging or filling operations. Accretion of groundwater in river flow may also affect water quality by altering dissolved oxygen levels and water temperature and introducing nutrients and toxicants. Other variables affecting water quality include flow, substrate, physical habitat, and physical, chemical and biological processes.

WATER TEMPERATURE. Water temperature refers specifically to the temperature of water in stream channels including water released from storage reservoirs. Temperature does not include discharge of cooling water from electricity-generating plants or other facilities (discussed under "Thermal Pollution"). Water temperature is affected by weather, reservoir operations including operation of multilevel release structures, flow, tributary inflow, groundwater and physical habitat including shading by riparian vegetation.

AGRICULTURAL SALINITY. Agricultural salinity originates from dissolved salts in agricultural runoff.

THERMAL POLLUTION. Electricity-generating plants, sewage treatment plants and other facilities, and agricultural return flows discharge water at temperatures that may exceed the temperature of the receiving water. Discharge from future in-Delta water storage facilities could also exceed the temperature of the receiving water.

DISSOLVED OXYGEN. Low dissolved oxygen levels may result from the discharge of organic material such as treated sewage to Delta channels. Changes in dissolved oxygen levels in rivers and streams may result from reservoir discharge drawn from anoxic reservoir strata, reservoir discharge that supersaturates oxygen levels, and accretion of groundwater.

NUTRIENT AVAILABILITY. Inorganic nutrients enter aquatic and wetland ecosystems through agricultural runoff and sewage discharge. Nutrients can also enter the ecosystem through natural processes associated with physical (e.g., flood events that inundate terrestrial and wetlands habitats, natural runoff from storm events), chemical (e.g., dissolution of substrates) and biological (e.g., organic decomposition) processes. Leaching reduces nutrient availability in terrestrial ecosystems.

TOXICANTS. Toxicants have acute and chronic effects and therefore reduce the survival of fish and other aquatic organisms. Toxicants include pesticides, metals, and other chemicals that enter the aquatic ecosystem through agricultural runoff, direct application (e.g., aquatic weed control), industrial discharge, dredging, mine drainage, sewage discharge and urban runoff.

TRANSPARENCY. Transparency is the ability of light to penetrate water. Transparency is a function of the concentration and the chemical and physical properties of inorganic and organic sediments, algae, other organic particles and dissolved materials. Natural (e.g., flow- and wind-driven mixing and erosion, decomposing vegetation and algal populations) and human-induced processes (e.g., dredging, dredge disposal, sewage discharge and boat wakes) affect transparency.

Species Interactions

Species interactions depend on a broad range of biological factors. Species interactions may change substantially in response to other changes in the environmental variables discussed above.

PREDATION. Predation occurs naturally; however, organisms that are already stressed by poor habitat conditions, including toxicants, elevated water temperature, turbulence created by barriers and other factors may be more susceptible to predation and therefore to additional mortality. Predation may also increase with the introduction of non-native species.

COMPETITION. Competition occurs when the use of a resource such as food or habitat by one individual reduces the availability of the same resource for another individual. Competition occurs within a species population and between species. As with predation, organisms already stressed by other factors may be less able to compete for limited resources, and species survival could decline. The introduction of non-native species with resource needs similar to those of native species may increase competition for limited resources.

DISEASE. Disease refers to fungi, bacteria, viruses, parasites and other pathogens that may limit species population abundance. The pathogens may be natural or introduced, and the effects may vary depending on interactions with other environmental variables.

NON-NATIVE PLANTS. Introduction of non-native plants to aquatic habitats may affect species population abundance by modifying substrate, physical habitat, water circulation, water quality and changing species interactions. Introduction of non-native plants to wetland and terrestrial habitats may threaten the continued existence of native special-status plants as a result of competition.

Harvest

Harvest of fish and other aquatic species includes commercial fishing, sport fishing and illegal fishing activities that cause or contribute to the death of individuals in a species population. Harvest of wetland and terrestrial wildlife species includes hunting, poaching and, in the case of terrestrial and wetland plants, mowing and collecting.

Artificial Production

Artificial production is the human-aided production of a species in facilities, such as fish hatcheries and rearing pens, that are isolated to some degree from the natural ecosystem. The produced individuals are released to supplement wild populations or establish new populations and provide fishing and hunting opportunities.

MAJOR RELEVANT GIS DATA BASES FOR PROGRAMMATIC VEGETATION AND WILDLIFE IMPACT ASSESSMENT

Resource Category	Organization	Geographic Coverage
Wetlands	Natural Heritage Division - California Department of Fish and Game	Sacramento Valley from Stony Creek area to Gravelly Ford on the San Joaquin River, including the Delta and Bay Area
Wetlands	National Wetland Inventory - U.S. Fish and Wildlife Service	California (incomplete)
Habitats	California Gap Analysis Program (UC Santa Barbara, UC Davis)	California
Bay lands (mudflats, tidal marsh, diked baylands, riparian)	San Francisco Estuary Institute	Bay/Delta downstream from Broad Slough
Agricultural habitats	Department of Water Resources	Most of Central Valley by county
Special-status species and communities	Natural Diversity Data Base - California Department of Fish and Game	California

CATEGORIES OF IMPACT ANALYSIS

Area of Natural Communities

Changes in acreage of these natural communities will be assessed for each alternative. The natural communities will be identified according to vegetation type, subtype, component plant species and associated wildlife species.

Quality of Natural Communities

The quality of natural communities directly affects the health of associated plant and wildlife species that are found in, or are dependent upon, these communities. The quality of a community is related to the diversity of species present, the resilience of the species populations, the size of the community and the relationship of the community to other communities.

Area of Agricultural Land

As with the natural communities, some wildlife species are dependent on agricultural lands during all or part of their life history. This association sometimes depends on specific cropping patterns. Therefore, changes in acreage of agricultural lands will be assessed for each alternative. The agricultural lands will be identified according to cropping patterns and associated plant and wildlife species.

Habitat Patterns

Changes in habitat patterns may directly affect vegetation and wildlife species dependent on the orientation of certain habitat types that will meet a critical life history need, such as nesting. Changes in habitat patterns may indirectly affect species in an adjacent habitat by affecting a food source or by eliminating or creating natural corridors for plant and wildlife species dispersion (including gene exchange), for example. Variables which can be used to measure changes to habitat patterns include size, shape and number of habitat types in a region.

Number of Known Special-Status and/or Areas with Critical Habitat Designation

The impacts on special-status species or critical habitat could include reduction in numbers in a local area or direct loss. Since special-status species occur in distinct areas and in some cases, such as for plants, very small discrete sites, determining specific impacts will be difficult. Assessment of impacts will be based on the potential to impact a species critical habitat or its range.

Area and Quality of Habitat Occupied by Special-Status Species

Each special-status species has specific habitat requirements for their reproduction and survival. An analysis of potential impacts that affect the area and quality of these habitats (see descriptions above) will be used as a measure of relative affects on these special-status species under each alternative.

Area and Quality and Special-Status Vegetative Communities

Special-status vegetative communities area subtypes of wetlands and riparian habitats and other communities that are considered rare by the Department of Fish and Game. Assessment of changes in the quality of special-status communities will be based on an analysis of changes in the environmental factors that determine the reproduction and growth of plant species constituting the communities.

PROCESSES, HABITATS AND STRESSORS

Processes

Ecological processes act directly, indirectly or in combination to shape and form the ecosystem including streamflow, watershed, stream channel and floodplain processes. Watershed processes are closely linked to streamflow and include fire and erosion. Stream channel processes include stream meander, gravel recruitment and transport, water temperature and hydraulic conditions. Floodplain processes include overbank flooding and sediment retention and deposition.

Habitats

Habitats are areas that provide specific conditions necessary to support plant, fish and wildlife communities. Some important habitats include gravel bars and riffles for salmon spawning beds, winter seasonal floodplains that support juvenile fish and waterbirds, and shallow near-shore aquatic habitat shaded by tule marsh and overhanging riparian forest.

Stressors

Stressors are natural and unnatural events or activities that adversely affect ecosystem processes, habitats and species. Environmental stressors include water diversions, water contaminants, levee confinement, stream channelization and bank armoring, mining and dredging in streams and estuaries, excessive harvest of fish and wildlife, introduced predator and competitor species, and invasive plants in aquatic and riparian zones. Some major stressors affecting the ecosystem are permanent features on the landscape such as large dams and reservoirs that block transport of the natural supply of woody debris and sediment in rivers or alter unimpaired flows.

AQUATIC COMMUNITIES

Aquatic communities are divisions of the aquatic ecosystem that consist of the connected sequences of water bodies through which aquatic species pass as they complete their life cycles. The aquatic ecosystem has been divided into five communities based on occurrence of fish and invertebrate species and on habitat conditions that could be affected by CALFED actions.

- **The reservoir community** includes habitat within Central Valley reservoirs. The impact assessment will focus on the major downstream reservoirs on Central Valley rivers (e.g., Shasta and Folsom Lakes and Lake Oroville). The potential effects on reservoirs farther upstream (and the associated stream reaches between reservoirs) will be acknowledged but not evaluated in detail. Upstream reservoir operations are unlikely to be described in the Programmatic EIR/EIS, and site-specific environmental documentation of potential effects on specific upstream reservoirs may be required during implementation of project-specific CALFED actions.

- **The coldwater riverine community** encompasses the stream and river reaches below the downstream reservoirs and provides spawning habitat for chinook salmon. The habitat is accessible to chinook salmon and meets the species' habitat needs, as defined by velocity, depth, substrate size and adequate water temperature for spawning and incubation. The coldwater riverine community includes small tributary streams (e.g., Mill, Battle and Clear Creeks) and portions of major rivers (e.g., the Feather, Yuba, Sacramento and Tuolumne).

- **The warmwater riverine community** is located in the river reaches downstream of the coldwater riverine community and extends to the upstream edge of the Sacramento-San Joaquin Delta. In general, the warmwater riverine community includes portions of major rivers (e.g., the Feather, Yuba, Sacramento and Tuolumne).

- **The Delta-estuarine community** extends from the downstream edge of the warmwater riverine community to the upstream edge of the bay-marine community and includes tidally influenced habitat ranging in salinity from 0 to 10 parts per thousand (ppt). The Delta-estuarine community includes the Sacramento-San Joaquin Delta and usually includes most of Suisun Bay and Suisun Marsh.

- **The bay-marine community** extends from the downstream edge of the Delta-estuarine community to the Golden Gate Bridge in tidally influenced habitat with salinity exceeding 10 ppt. The bay-marine community includes San Francisco Bay and usually includes San Pablo Bay.

With the exception of the reservoir community, the geographic boundaries between these aquatic communities are not clearly defined. Under varying hydrologic and meteorologic conditions, the upstream and downstream boundaries shift. During wet years, the downstream boundaries of all communities (except the reservoir community) shift toward San Francisco Bay. During dry years, the downstream boundaries shift upstream toward dams or headwaters. Additional division of the aquatic communities into specific rivers and streams may be required to address specific actions included in the CALFED alternatives.

SPECIES SELECTED FOR INCLUSION IN THE FISH IMPACT ASSESSMENT

Species (Common/Scientific Name)		Aquatic Community				
		Reservoir	Cold Water	Warm Water	Estuarine	Marine
Fish						
Rainbow trout	*Oncorhynchus mykiss*	X				
Largemouth bass	*Micropterus salmoides*	X			X	
White sturgeon	*Acipenser transmontanus*		X	X	X	X
Chinook salmon	*Oncorhynchus tshawytscha*		X	X	X	X
Steelhead trout	*Oncorhynchus mykiss*		X	X	X	
Sacramento squawfish	*Ptychocheilus grandis*		X	X		
American shad	*Alosa sapidissima*			X	X	
Sacramento blackfish	*Orthodon microlepidotus*			X	X	
Sacramento splittail	*Pogonichthys macrolepidotus*			X	X	
Striped bass	*Morone saxatilis*			X	X	X
Smallmouth bass	*Micropterus dolomieui*			X		
Tule perch	*Hysterocarpus traskii*			X	X	
Delta smelt	*Hypomesus transpacificus*				X	
Longfin smelt	*Spirinchus thaleichthys*				X	X
White catfish	*Ictalurus catus*				X	
Inland silverside	*Menidia audens*				X	
Pacific herring	*Clupea harengeus pallasii*					X
Starry flounder	*Platichthys stellatus*					X
Invertebrate						
Terrestrial invertebrates			X	X	X	
Other aquatic invertebrates			X	X		
Rotifers	*Rotifera*				X	
Native mysid shrimp	*Neomysis mercedis*				X	
Crayfish	*Pacifastacus leniusculus*			X	X	
Asian clam	*Potamocorbula amurensis*				X	X
Bay shrimp	*Crangon franciscorum*					X